

## CLAIMS

What is claimed is:

1 1. A method comprising:  
2 transferring data on a first port during a current cycle until a predetermined number of  
3 bytes less an overshoot value for the first port has been transferred on the first  
4 port;  
5 continuing to transfer data on the first port during the current cycle until a complete  
6 packet has been transferred on the first port; and  
7 updating the overshoot value for the first port based on the number of bytes transferred  
8 on the first port.

1 2. The method of claim 1, wherein the updating of the overshoot value for the first  
2 port based on the number of bytes transferred on the first port comprises:  
3 upon determining that the number of bytes transferred on the first port is greater than the  
4 predetermined number of bytes less the overshoot value for the first port, setting  
5 the overshoot value for the first port to the number of bytes transferred on the first  
6 port in excess of the predetermined number less the overshoot value for the first  
7 port.

1 3. The method of claim 1, wherein the updating of the overshoot value for the first  
2 port based on the number of bytes transferred on the first port comprises:  
3 upon determining that the number of bytes transferred on the first port is not greater than  
4 the predetermined number of bytes less the overshoot value for the first port,  
5 setting the overshoot value for the first port to zero.

1 4. The method of claim 1, further comprising:

2 transferring data on an Nth port during a current cycle until a predetermined number of  
3 bytes less an overshoot value for the Nth port has been transferred on the Nth  
4 port;  
5 continuing to transfer data on the Nth port during the current cycle until a complete  
6 packet has been transferred on the Nth port; and  
7 updating the overshoot value for the Nth port based on the number of bytes transferred on  
8 the Nth port.

1 5. The method of claim 4, wherein the updating of the overshoot value for the Nth  
2 port based on the number of bytes transferred on the Nth port comprises:  
3 upon determining that the number of bytes transferred on the Nth port is greater than the  
4 predetermined number of bytes less the overshoot value for the Nth port, setting  
5 the overshoot value for the Nth port to the number of bytes transferred on the Nth  
6 port in excess of the predetermined number less the overshoot value for the Nth  
7 port.

1 6. The method of claim 4, wherein the updating of the overshoot value for the Nth  
2 port based on the number of bytes transferred on the Nth port comprises:  
3 upon determining that the number of bytes transferred on the Nth port is not greater than  
4 the predetermined number of bytes less the overshoot value for the Nth port,  
5 setting the overshoot value for the Nth port to zero.

1 7. A method comprising:  
2 upon determining that a number of bytes transferred on a first port during a current cycle  
3 is not greater than a predetermined number of bytes less an overshoot value for  
4 the first port and a packet was not transferred by the first port during the current  
5 cycle, maintaining the overshoot value for the first port; and

6 upon determining that a number of bytes transferred on a first port during a current cycle  
7 is not greater than the predetermined number of bytes less the overshoot value for  
8 the first port and a packet was transferred by the first port during the current  
9 cycle, setting the overshoot value to zero.

1 8. A method comprising:

2 upon determining that a packet may be transferred on a first port during a current cycle,  
3 transferring data on the first port during the current cycle until a predetermined  
4 number of bytes less an overshoot value for the first port has been transferred on  
5 the first port;

6 upon determining that a packet has been partially transferred on the first port during the  
7 current cycle, continuing to transfer data on the first port during the current cycle  
8 until a complete packet has been transferred on the first port; and  
9 updating the overshoot value for the first port based on the number of bytes transferred  
10 on the first port.

1 9. The method of claim 8, wherein the updating of the overshoot value for the first  
2 port based on the number of bytes transferred on the first port comprises:

3 upon determining that the number of bytes transferred on the first port is not greater than  
4 the predetermined number of bytes less the overshoot value for the first port,  
5 reducing up to a predetermined limit the overshoot value for the first port by the  
6 number of bytes transferred on the first port during the current cycle less than the  
7 predetermined number of bytes less the overshoot value for the first port.

1 10. A method comprising:

2 upon determining that the number of bytes transferred on a first port during a current  
3 cycle is not greater than a predetermined number of bytes less an overshoot value

4 for the first port, reducing the overshoot value for the first port by a number of  
5 bytes transferred by the first port during the current cycle less than the  
6 predetermined number of bytes less the overshoot value for the first port; and  
7 upon determining that the reducing would cause the overshoot value for the first port to  
8 become negative, adding the predetermined number of bytes to the overshoot  
9 value for the first port.

1 11. A method comprising:  
2 sequentially selecting a pair of ports from a plurality of pairs of ports wherein the pair of  
3 ports comprises a port connected to a first interface and a port connected to a  
4 second interface;  
5 transferring data on the port connected to the first interface during a current cycle; and  
6 transferring data on the port connected to the second interface during the current cycle.

1 12. The method of claim 11, wherein one pair of ports of the plurality of pairs of ports  
2 comprises a port reserved for MDLs and a port reserved for FDLs.

1 13. The method of claim 11, further comprising:  
2 selecting a port reserved for MDLs;  
3 transferring data on the port reserved for MDLs during the current cycle;  
4 selecting a port reserved for FDLs; and  
5 transferring data on the port reserved for FDLs during the current cycle.

1 14. An apparatus comprising:  
2 a first port to transfer data during a current cycle until a predetermined number of bytes  
3 less an overshoot value for the first port has been transferred on the first port and

4 to continue to transfer data during the current cycle until a complete packet has  
5 been transferred on the first port; and  
6 a first residue counter coupled with the first port to update the overshoot value for the  
7 first port based on the number of bytes transferred on the first port.

1 15. The apparatus of claim 14, wherein the first residue counter, to update the  
2 overshoot value for the first port based on the number of bytes transferred on the first  
3 port, is to set the overshoot value for the first port to the number of bytes transferred on  
4 the first port in excess of the predetermined number less the overshoot value for the first  
5 port upon determining that the number of bytes transferred on the first port is greater than  
6 the predetermined number of bytes less the overshoot value for the first port.

1 16. The apparatus of claim 14, wherein the first residue counter, to update the  
2 overshoot value for the first port based on the number of bytes transferred on the first  
3 port, is to set the overshoot value for the first port to zero upon determining that the  
4 number of bytes transferred on the first port is not greater than the predetermined number  
5 of bytes less the overshoot value for the first port.

1 17. The apparatus of claim 14, wherein the first residue counter, to update the  
2 overshoot value for the first port based on the number of bytes transferred on the first  
3 port, is to maintain the overshoot value for the first port upon determining that the  
4 number of bytes transferred on the first port is not greater than the predetermined number  
5 of bytes less the overshoot value for the first port and a packet was not transferred by the  
6 first port during the current cycle, and is to set the overshoot value to zero upon  
7 determining that the number of bytes transferred on the first port is not greater than the  
8 predetermined number of bytes less the overshoot value for the first port and a packet  
9 was transferred by the first port during the current cycle.

1       18. The apparatus of claim 14, wherein the first residue counter, to update the  
2       overshoot value for the first port based on the number of bytes transferred on the first  
3       port, is to reduce up to a predetermined limit the overshoot value for the first port by the  
4       number of bytes transferred on the first port during the current cycle less than the  
5       predetermined number of bytes less the overshoot value for the first port upon  
6       determining that the number of bytes transferred on the first port is not greater than the  
7       predetermined number of bytes less the overshoot value for the first port.

1       19. The apparatus of claim 14, further comprising:  
2       an Nth port to transfer data during a current cycle until a predetermined number of bytes  
3       less an overshoot value for the Nth port has been transferred on the Nth port and  
4       to continue to transfer data during the current cycle until a complete packet has  
5       been transferred on the Nth port; and  
6       an Nth residue counter coupled with the Nth port to update the overshoot value for the  
7       Nth port based on the number of bytes transferred on the Nth port.

1       20. The apparatus of claim 19, wherein the Nth residue counter, to update the  
2       overshoot value for the Nth port based on the number of bytes transferred on the Nth  
3       port, is to set the overshoot value for the Nth port to the number of bytes transferred on  
4       the Nth port in excess of the predetermined number less the overshoot value for the Nth  
5       port upon determining that the number of bytes transferred on the Nth port is greater than  
6       the predetermined number of bytes less the overshoot value for the Nth port.

1       21. The apparatus of claim 19, wherein the Nth residue counter, to update the  
2       overshoot value for the Nth port based on the number of bytes transferred on the Nth  
3       port, is to set the overshoot value for the Nth port to zero upon determining that the

4 number of bytes transferred on the Nth port is not greater than the predetermined number  
5 of bytes less the overshoot value for the Nth port.

1 22. An apparatus comprising:  
2 a plurality of pairs of ports wherein a pair of ports comprises a port connected to a first  
3 interface to transfer data during a current cycle and a port connected to a second  
4 interface to transfer data during the current cycle; and  
5 a bandwidth balancing arbiter coupled with the plurality of ports to sequentially select  
6 each pair of ports of the plurality of pairs of ports to transfer data during the  
7 current cycle.

1 23. The apparatus of claim 22, wherein the plurality of pairs of ports further  
2 comprises one pair of ports comprising a port reserved for MDLs and a port reserved for  
3 FDLs.

1 24. The apparatus of claim 22, further comprising:  
2 a port reserved for MDLs; and  
3 a port reserved for FDLs.

1 25. A machine-readable medium that provides instructions that, when executed by a  
2 machine, cause the machine to perform operations comprising:  
3 transferring data on a first port during a current cycle until a predetermined number of  
4 bytes less an overshoot value for the first port has been transferred on the first  
5 port;  
6 continuing to transfer data on the first port during the current cycle until a complete  
7 packet has been transferred on the first port; and

8 updating the overshoot value for the first port based on the number of bytes transferred  
9 on the first port.

1 26. The machine-readable medium of claim 25, wherein the updating of the overshoot  
2 value for the first port based on the number of bytes transferred on the first port  
3 comprises:

4 upon determining that the number of bytes transferred on the first port is greater than the  
5 predetermined number of bytes less the overshoot value for the first port, setting  
6 the overshoot value for the first port to the number of bytes transferred on the first  
7 port in excess of the predetermined number less the overshoot value for the first  
8 port.

1 27. The machine-readable medium of claim 25, wherein the updating of the overshoot  
2 value for the first port based on the number of bytes transferred on the first port  
3 comprises:

4 upon determining that the number of bytes transferred on the first port is not greater than  
5 the predetermined number of bytes less the overshoot value for the first port,  
6 setting the overshoot value for the first port to zero.

1 28. The machine-readable medium of claim 25, wherein operations further comprise:  
2 transferring data on an Nth port during a current cycle until a predetermined number of  
3 bytes less an overshoot value for the Nth port has been transferred on the Nth  
4 port;  
5 continuing to transfer data on the Nth port during the current cycle until a complete  
6 packet has been transferred on the Nth port; and  
7 updating the overshoot value for the Nth port based on the number of bytes transferred on  
8 the Nth port.

1 29. The machine-readable medium of claim 28, wherein the updating of the overshoot  
2 value for the Nth port based on the number of bytes transferred on the Nth port  
3 comprises:  
4 upon determining that the number of bytes transferred on the Nth port is greater than the  
5 predetermined number of bytes less the overshoot value for the Nth port, setting  
6 the overshoot value for the Nth port to the number of bytes transferred on the Nth  
7 port in excess of the predetermined number less the overshoot value for the Nth  
8 port.

1 30. The machine-readable medium of claim 28, wherein the updating of the overshoot  
2 value for the Nth port based on the number of bytes transferred on the Nth port  
3 comprises:  
4 upon determining that the number of bytes transferred on the Nth port is not greater than  
5 the predetermined number of bytes less the overshoot value for the Nth port,  
6 setting the overshoot value for the Nth port to zero.

1 31. A machine-readable medium that provides instructions that, when executed by a  
2 machine, cause the machine to perform operations comprising:  
3 upon determining that a number of bytes transferred on a first port during a current cycle  
4 is not greater than a predetermined number of bytes less an overshoot value for  
5 the first port and a packet was not transferred by the first port during the current  
6 cycle, maintaining the overshoot value for the first port; and  
7 upon determining that a number of bytes transferred on a first port during a current cycle  
8 is not greater than the predetermined number of bytes less the overshoot value for  
9 the first port and a packet was transferred by the first port during the current  
10 cycle, setting the overshoot value to zero.

1       32. A machine-readable medium that provides instructions that, when executed by a  
2       machine, cause the machine to perform operations comprising:  
3       upon determining that a packet may be transferred on a first port during a current cycle,  
4       transferring data on the first port during the current cycle until a predetermined  
5       number of bytes less an overshoot value for the first port has been transferred on  
6       the first port;  
7       upon determining that a packet has been partially transferred on the first port during the  
8       current cycle, continuing to transfer data on the first port during the current cycle  
9       until a complete packet has been transferred on the first port; and  
10      updating the overshoot value for the first port based on the number of bytes transferred  
11      on the first port.

1       33. The machine-readable medium of claim 32, wherein the updating of the overshoot  
2       value for the first port based on the number of bytes transferred on the first port  
3       comprises:  
4       upon determining that the number of bytes transferred on the first port is not greater than  
5       the predetermined number of bytes less the overshoot value for the first port,  
6       reducing up to a predetermined limit the overshoot value for the first port by the  
7       number of bytes transferred on the first port during the current cycle less than the  
8       predetermined number of bytes less the overshoot value for the first port.

1       34. A machine-readable medium that provides instructions that, when executed by a  
2       machine, cause the machine to perform operations comprising:  
3       sequentially selecting a pair of ports from a plurality of pairs of ports wherein the pair of  
4       ports comprises a port connected to a first interface and a port connected to a  
5       second interface;

6       transferring data on the port connected to the first interface during a current cycle; and  
7       transferring data on the port connected to the second interface during the current cycle.

1       35.      The machine-readable medium of claim 34, wherein one pair of ports of the  
2       plurality of pairs of ports comprises a port reserved for MDLs and a port reserved for  
3       FDLs.

1       36.      The machine-readable medium of claim 34, wherein operations further comprise:  
2       selecting a port reserved for MDLs;  
3       transferring data on the port reserved for MDLs during the current cycle;  
4       selecting a port reserved for FDLs; and  
5       transferring data on the port reserved for FDLs during the current cycle.

1       37.      A machine-readable medium that provides instructions that, when executed by a  
2       machine, cause the machine to perform operations comprising:  
3       upon determining that the number of bytes transferred on a first port during a current  
4               cycle is not greater than a predetermined number of bytes less an overshoot value  
5               for the first port, reducing the overshoot value for the first port by a number of  
6               bytes transferred by the first port during the current cycle less than the  
7               predetermined number of bytes less the overshoot value for the first port; and  
8       upon determining that the reducing would cause the overshoot value for the first port to  
9               become negative, adding the predetermined number of bytes to the overshoot  
10          value for the first port.

1       38.      A network element comprising:  
2       at least one line card coupled to receive data, wherein the at least one line card comprises,

3 a first port to transfer the data during a current cycle until a predetermined number  
4 of bytes less an overshoot value for the first port has been transferred on  
5 the first port and to continue to transfer the data during the current cycle  
6 until a complete packet has been transferred on the first port; and  
7 a first residue counter coupled with the first port to update the overshoot value for  
8 the first port based on the number of bytes transferred on the first port.

1 39. The network element of claim 38, wherein the first residue counter, to update the  
2 overshoot value for the first port based on the number of bytes transferred on the first  
3 port, is to set the overshoot value for the first port to the number of bytes transferred on  
4 the first port in excess of the predetermined number less the overshoot value for the first  
5 port upon determining that the number of bytes transferred on the first port is greater than  
6 the predetermined number of bytes less the overshoot value for the first port.

1 40. The network element of claim 38, wherein the first residue counter, to update the  
2 overshoot value for the first port based on the number of bytes transferred on the first  
3 port, is to set the overshoot value for the first port to zero upon determining that the  
4 number of bytes transferred on the first port is not greater than the predetermined number  
5 of bytes less the overshoot value for the first port.

1 41. The network element of claim 38, wherein the first residue counter, to update the  
2 overshoot value for the first port based on the number of bytes transferred on the first  
3 port, is to maintain the overshoot value for the first port upon determining that the  
4 number of bytes transferred on the first port is not greater than the predetermined number  
5 of bytes less the overshoot value for the first port and a packet was not transferred by the  
6 first port during the current cycle, and is to set the overshoot value to zero upon  
7 determining that the number of bytes transferred on the first port is not greater than the

8 predetermined number of bytes less the overshoot value for the first port and a packet  
9 was transferred by the first port during the current cycle.

1 42. The network element of claim 38, wherein the first residue counter, to update the  
2 overshoot value for the first port based on the number of bytes transferred on the first  
3 port, is to reduce up to a predetermined limit the overshoot value for the first port by the  
4 number of bytes transferred on the first port during the current cycle less than the  
5 predetermined number of bytes less the overshoot value for the first port upon  
6 determining that the number of bytes transferred on the first port is not greater than the  
7 predetermined number of bytes less the overshoot value for the first port.

1 43. The network element of claim 38, wherein the at least one line card further  
2 comprises:  
3 an Nth port to transfer data during a current cycle until a predetermined number of bytes  
4 less an overshoot value for the Nth port has been transferred on the Nth port and  
5 to continue to transfer data during the current cycle until a complete packet has  
6 been transferred on the Nth port; and  
7 an Nth residue counter coupled with the Nth port to update the overshoot value for the  
8 Nth port based on the number of bytes transferred on the Nth port.

1 44. The network element of claim 43, wherein the Nth residue counter, to update the  
2 overshoot value for the Nth port based on the number of bytes transferred on the Nth  
3 port, is to set the overshoot value for the Nth port to the number of bytes transferred on  
4 the Nth port in excess of the predetermined number less the overshoot value for the Nth  
5 port upon determining that the number of bytes transferred on the Nth port is greater than  
6 the predetermined number of bytes less the overshoot value for the Nth port.

1 45. The network element of claim 43, wherein the Nth residue counter, to update the  
2 overshoot value for the Nth port based on the number of bytes transferred on the Nth  
3 port, is to set the overshoot value for the Nth port to zero upon determining that the  
4 number of bytes transferred on the Nth port is not greater than the predetermined number  
5 of bytes less the overshoot value for the Nth port.

1 46. An network element comprising:  
2 at least one line card coupled to receive data, wherein the at least one line card comprises,  
3 a plurality of pairs of ports wherein a pair of ports comprises a port connected to a  
4 first interface to transfer data during a current cycle and a port connected  
5 to a second interface to transfer data during the current cycle; and  
6 a bandwidth balancing arbiter coupled with the plurality of ports to sequentially  
7 select each pair of ports of the plurality of pairs of ports to transfer data  
8 during the current cycle.

1 47. The network element of claim 46, wherein the plurality of pairs of ports further  
2 comprises one pair of ports comprising a port reserved for MDLs and a port reserved for  
3 FDLs.

1 48. The network element of claim 46, wherein the at least one line card further  
2 comprises:  
3 a port reserved for MDLs; and  
4 a port reserved for FDLs.